Internet Appendix to "Unfiltered Market Access and Liquidity: Evidence from the SEC Rule 15c3-5"

In this Appendix, we provide full regression results for the models reported in the main text and describe the setup of additional robustness checks and their results.

Tables A1-A7.

In Tables A1 through A7, we report full results for regression models referenced in Tables 1 through 9 in the main text. Full results for Table 5 are in the main text. The tables in this Appendix contain coefficient estimates and the corresponding standard errors for all control variables that are omitted from the tables in the paper, as well as statistics on the number of stocks, stock-day observations and the adjusted R^2.

Table A8.

In Panels A and D of Table A8, we report the coefficients of the $POST$ dummy from a base regression model that does not control for prices, volatility, and turnover (the controls used in the main tables):

$$DEPVAR_{it} = \alpha_i + \gamma_t + \beta_1 POST_t + \varepsilon_{it}, \quad \text{(A1)}$$

where $DEPVAR_{it}$ is the variable of interest for stock i on day t (i.e., price impact, effective spread, or realized spread), $POST$ is a post-CCTP dummy, and γ_t is a trend variable.

Next, in Panels B and E we replace a stock's own volatility in the main regression model (eq. 5 of the main text) with a VIX control:

$$DEPVAR_{it} = \alpha_i + \gamma_t + \beta_1 POST_t + \beta_2 IPRICE_{it} + \beta_3 VIX_t + \beta_4 TURN_{it} + \varepsilon_{it}, \quad \text{(A2)}$$

where $IPRICE$ is the inverse of the stock price, VIX is the CBOE volatility index, $TURN$ is daily

volume scaled by the number of shares outstanding, and all other variables are as previously defined.

Finally, in Panels C and F we return to controlling for a stock's own volatility, and use the spread and price impact metrics expressed in cents instead of metrics scaled by the corresponding NBBO midpoint (as was done for the main tables in the paper):

$$DEPVAR_{it} = \alpha_i + \gamma_t + \beta_1 POST_t + \beta_2 IPRICE_{it} + \beta_3 VOLAT_{it} + \beta_4 TURN_{it} + \varepsilon_{it}, \quad \text{(A3)}$$

where $DEPVAR_{it}$ is the variable of interest for stock i on day t (i.e., price impact, effective spread, or realized spread) expressed in cents, $VOLAT$ is the daily high minus low price scaled by the high price, and all other variables are as previously defined. In all Table A8 regressions, we control for stock fixed effects and double-cluster the standard errors.

The baseline regression models, the models that use a VIX control, and the models that express dependent variables in cents produce results similar to those reported in the main text. Our conclusions that the CCTP reduced adverse selection and effective spreads without affecting the realized spreads remain unchanged.

Table A9.

Table A9 reports coefficients from the regressions that allow the trend variable to vary across stock groups:

$$DEPVAR_{it} = \alpha_0 + \gamma_t + \beta_1 POST_t + \beta_2 \gamma \times GROUP2_{it} + \beta_3 \gamma \times GROUP3_{it} + \quad \text{(A4)}$$
$$\beta_4 GROUP2_{it} + \beta_5 GROUP3_{it} + \beta_6 IPRICE_{it} + \beta_7 VOLAT_{it} + \beta_8 TURN_{it} + \varepsilon_{it},$$

where $DEPVAR_{it}$ is one of the three price impact metrics for stock i on day t, $GROUP2$ and $GROUP3$ are dummy variables for the medium and small stocks, and all other variables are as previously defined.

The coefficient of the $POST$ variable does not change appreciably when we allow the trend to interact with the group dummies. In addition, the interaction coefficients (that capture the incremental difference between the trend in large stocks and the trends in medium and small stocks) are insignificant, suggesting that the medium and small stocks experience the same trend as the large stocks.

Table A10.

Although we control for the time trend in regressions, our results may be affected by seasonality due to the year-end effects. To examine this possibility, we carry out two robustness checks in Table A10. First, in Panel A, we estimate the main regression model (eq. 5 in the main text) for a four-month period surrounding a placebo date, November 30, 2012. This date is one year removed from the CCTP implementation date. In this regression, the $POST$ variable is insignificant, suggesting that the effect we capture around the November 30, 2011 implementation date is unlikely to be driven by seasonality.

Second, in Panel B of Table A10, we conduct a more formal test, in which we put the 2011 and 2012 four-month panels together and estimate the following model:

$$DEPVAR_{it} = \alpha_i + \gamma_t + \beta_1 POST_t + \beta_2 POST \times YR2011_t + \beta_3 YR2011_t + \beta_4 IPRICE_{it} + \beta_5 VOLAT_{it} + \beta_6 TURN_{it} + \varepsilon_{it}, \quad \text{(A5)}$$

where $YR2011$ is a dummy variable capturing the four months around the CCTP implementation, and all other variables are as previously defined. In this model, the $POST$ variable captures the post-November 30 effects that are common in both 2011 and 2012, whereas the $POST \times YR2011$ interaction term captures the effects unique to the 2011 period around the CCTP implementation. The results confirm that the effects present around the November 30, 2011 implementation of the

CCTP are unique to this event.

Table A11.

In Table A11, we recognize the possibility that the relations between the top-of-the-book executions and the number of quotes and trades may be nonlinear. To examine this possibility, we estimate the following model:

$$DEPVAR_{it} = \alpha_i + \gamma_t + \beta_1 POST_t + \beta_2 IPRICE_{it} + \beta_3 VOLAT_{it} + \beta_4 QUOTES_{it} + \beta_5 QUOTES_{it}^2 + \beta_6 TRADES_{it} + \beta_7 TRADES_{it}^2 + \varepsilon_{it}, \quad \text{(A6)}$$

where $DEPVAR_{it}$ is the proportion of top of the book executions in the 200 μs, 300 μs and 400 μs buckets for stock i on day t, $QUOTES$ is the number of quotes scaled by 100,000, $TRADES$ is the number of trades scaled by 100,000, and all other variables are as previously defined. Overall, this model is similar to the analysis reported in Table 2 of the main text, with an allowance for non-linearity.

The coefficients of the squared $QUOTES$ and $TRADES$ terms are significant in some specifications, suggesting that there is indeed some non-linearity in the relation between the market order reaction speed and the number of quotes and trades. This said, the coefficients on the $POST$ dummy are consistent with those in Table 2.

Table A12.

In Table A12, we examine price impacts, effective and realized spreads using true trade classification from ITCH instead of relying on the Lee and Ready (1991) algorithm to sign trades. Similar to the results obtained from DTAQ, price impacts and effective spreads decline after the implementation of the CCTP, and realized spreads remain unchanged.

We note that the ITCH and DTAQ samples produce comparable effective spreads, but price impacts and realized spreads from these two data sources notably differ. We are not the first researchers to document this discrepancy when using different data sources to compute realized spreads. Using 2008-2009 data from Nasdaq, Brogaard, Hendershott and Riordan (2014) show that liquidity provision is only profitable once liquidity rebates are accounted for. In other words, the realized spreads unadjusted for rebates are generally negative. We confirm this result using ITCH data (columns 3 and 4 of Table A12). Meanwhile, examining DTAQ data in 2008, Holden and Jacobsen (2014) report positive realized spreads. We confirm this result as well (columns 1 and 2). While data sampling frequency and time stamp differences may cause such discrepancies, fortunately for our present research, these discrepancies are not consequential. Both the DTAQ and ITCH analyses point to the same conclusions – price impacts and effective spreads decline after the CCTP implementation, and realized spreads remain unchanged.

Table A13.

In Table A13, we examine the trading and quoting activity as well as spreads in a sample of Canadian non-interlisted stocks. We begin with a list of all Canadian stocks from the Canadian Financial Markets Research Centre (CFMRC) database. Some Canadian stocks are interlisted (trade both in Canada and in the U.S.) and therefore may be directly affected by the CCTP. We exclude such stocks from the sample by collecting a list of interlisted firms from the September 2011-January 2012 eReviews published by the Toronto Stock Exchange. We match the remaining Canadian stocks to the U.S. sample stocks by market capitalization in September 2011.

We note two important limitations of working with Canadian data. First, Canadian firms are generally smaller than the U.S. firms. As such, we are able to find good capitalizations matches

only for the medium and small U.S. stocks. In Table A14, we therefore focus on the 80 medium and small U.S. firms from the main sample. Second, our Canadian equities data are at the stock-day level, requiring us to use an alternative to the high-frequency liquidity cost metrics used in the main text. Specifically, we use the spread estimator of Corwin and Schultz (2012), $CSSE$.

Panel A of Table A13 reports the summary statistics for the U.S. and Canadian samples. Panel B reports coefficient estimates from the following model:

$$DEPVAR_{it} = \alpha_0 + \beta_1 POST_t + \beta_2 POST \times US_{it} + \beta_3 US_{it} + \beta_4 IPRICE_{it} + \beta_5 VOLAT_{it} + \beta_6 TURN_{it} + \varepsilon_{it}, \quad \text{(A7)}$$

where US is the U.S. sample dummy, and all other variables are as previously defined.

The univariate (Panel A) and regression (Panel B) results corroborate our earlier findings. The coefficients on the interaction term $\times US$, which represents the incremental effect of November 30, 2011 on the U.S. sample, are consistent with the main findings. Overall, quoting and trading activity declines and liquidity improves for the U.S. sample relative to the Canadian sample after the CCTP implementation.

Table A1: Price impacts around the CCTP implementation (full regression results)

The table contains coefficient estimates for the full sample, large, medium and small stocks from the following regression:

$$PRIMP_{it} = \alpha_i + \gamma_t + \beta_1 POST_t + \beta_2 IPRICE_{it} + \beta_3 VOLAT_{it} + \beta_4 TURN_{it} + \varepsilon_{it}$$

where $PRIMP_{it}$ is computed for each stock i on each day t as a volume-weighted signed difference between the NBBO midpoint 1, 5 or 15 seconds after a trade and the midpoint contemporaneous to the trade. Trades are signed using the Lee-Ready algorithm. Price impact is scaled by the corresponding NBBO midpoint and multiplied by 100. $POST$ is a post-CCTP dummy, $IPRICE$ is the inverse of the stock price, $VOLAT$ is the daily high minus low price scaled by the high price, $TURN$ is daily volume scaled by the number of shares outstanding, and γ_t is a trend variable. The regressions control for stock fixed effects. Double-clustered standard errors are in parentheses. Asterisks ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels.

	1s	5s	15s	1s	5s	15s	1s	5s	15s	1s	5s	15s
	full sample			large stocks			medium stocks			small stocks		
$POST$	-0.004***	-0.005***	-0.007***	-0.004***	-0.003***	-0.002***	-0.003**	-0.005***	-0.007***	-0.004***	-0.007***	-0.010***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)
$IPRICE$	0.271***	0.372***	0.511***	0.078	0.277*	0.457***	0.457***	0.564***	0.717***	0.246***	0.335***	0.469***
	(0.050)	(0.082)	(0.102)	(0.163)	(0.152)	(0.168)	(0.054)	(0.051)	(0.091)	(0.041)	(0.083)	(0.102)
$VOLAT$	0.036*	0.078**	0.116***	0.065**	0.078***	0.088***	0.019	0.039	0.043	0.037	0.106**	0.171**
	(0.021)	(0.031)	(0.042)	(0.027)	(0.028)	(0.029)	(0.027)	(0.037)	(0.047)	(0.026)	(0.048)	(0.070)
$TURN$	0.101***	0.194***	0.216***	-0.048	0.004	0.046	0.095	0.164**	0.220**	0.123**	0.239***	0.243**
	(0.035)	(0.057)	(0.078)	(0.045)	(0.051)	(0.057)	(0.058)	(0.083)	(0.109)	(0.053)	(0.086)	(0.120)
γ	-0.001	-0.011	-0.002	-0.001	-0.004	-0.001	-0.004	-0.014	-0.019	0.001	-0.015	-0.022
	(0.975)	(0.010)	(0.078)	(0.008)	(0.008)	(0.007)	(0.010)	(0.013)	(0.015)	(0.013)	(0.018)	(0.022)
# obs.	9,600	9,600	9,600	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200
# sym.	120	120	120	40	40	40	40	40	40	40	40	40
Adj. R^2	0.066	0.110	0.124	0.176	0.189	0.180	0.079	0.114	0.120	0.057	0.113	0.147

Table A2: Liquidity taker reaction speed (full regression results)

The table examines the speed of liquidity takers' reactions to new top of the book quotes. The reaction speed is measured as the difference between the time a top of the book quote is traded against and the time this quote was posted. We split reaction speeds into the following time buckets: 1 microseconds (µs), 10 µs, 100 µs, 200 µs, …, 900 µs, and 900+ µs. We then compute the proportion of trades in each bucket. We report coefficient estimates from the following regression:

$$DEPVAR_{it} = \alpha_i + \gamma_t + \beta_1 POST_t + \beta_2 IPRICE_{it} + \beta_3 VOLAT_{it} + \beta_4 QUOTES_{it} + \beta_5 TRADES_{it} + \varepsilon_{it},$$

where $DEPVAR_{it}$ is the proportion of top of the book executions in each time bucket for stock i on day t, $POST$ is a post-CCTP dummy, $IPRICE$ is the inverse of the stock price, $VOLAT$ is the daily high minus low price scaled by the high price, $QUOTES$ is the natural log of the number of top-of-the-book limit orders, $TRADES$ is the natural log of the number of ITCH trades, and γ_t is a trend variable. The regressions are estimated for the full sample (Panel A), large (Panel B), medium (Panel C), and small (Panel D) stocks. The regressions control for stock fixed effects. Double-clustered standard errors are in parentheses. Asterisks ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels.

	1 µs	10 µs	100 µs	200 µs	300 µs	400 µs	500 µs	600 µs	700 µs	800 µs	900 µs	900+ µs
Panel A: full sample												
$POST$	-0.000	0.000	-0.001	-0.021***	-0.001***	-0.001***	-0.000	-0.000*	-0.000	-0.000*	-0.000	0.025***
	(0.000)	(0.000)	(0.000)	(0.003)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.004)
$IPRICE$	-0.000	-0.010**	-0.029*	-0.150	-0.022	-0.011	-0.014	-0.013	-0.002	-0.009	-0.009	0.268
	(0.000)	(0.004)	(0.016)	(0.153)	(0.016)	(0.013)	(0.012)	(0.012)	(0.007)	(0.009)	(0.007)	(0.233)
$VOLAT$	0.001***	0.008***	0.013	0.145***	-0.002	-0.005*	-0.005	-0.004	-0.007***	0.002	-0.001	-0.145**
	(0.000)	(0.002)	(0.010)	(0.055)	(0.005)	(0.003)	(0.004)	(0.003)	(0.002)	(0.004)	(0.004)	(0.069)
$QUOTES$	-0.000	0.000***	0.003***	0.026***	0.002***	0.001**	0.001**	0.001	0.000	0.000*	0.000	-0.035***
	(0.000)	(0.000)	(0.001)	(0.006)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.008)
$TRADES$	0.000	0.000	0.002**	-0.014***	0.001**	0.001***	0.001***	0.001***	0.001***	0.000	0.000	0.006
	(0.000)	(0.000)	(0.001)	(0.005)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.006)
γ	-0.000***	-0.003***	0.028***	-0.033*	0.003	0.007***	0.003	0.004**	0.005***	0.005***	0.003	-0.021
	(0.000)	(0.001)	(0.007)	(0.019)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.031)
# obs.	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600
# sym.	120	120	120	120	120	120	120	120	120	120	120	120
Adj. R^2	-0.009	0.014	0.036	0.195	0.053	0.011	0.006	0.001	0.001	-0.007	-0.012	0.167

	1 µs	10 µs	100 µs	200 µs	300 µs	400 µs	500 µs	600 µs	700 µs	800 µs	900 µs	900+ µs
Panel B: large stocks												
POST	0.000	0.000	-0.001	-0.007***	-0.002***	-0.001***	-0.001***	-0.000	-0.000	-0.000	-0.000*	0.011***
	(0.000)	(0.000)	(0.001)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.003)
IPRICE	-0.000	-0.006	-0.025	-0.187	-0.016	0.001	-0.002	0.009	0.003	0.011	-0.001	0.213
	(0.001)	(0.008)	(0.048)	(0.194)	(0.057)	(0.042)	(0.030)	(0.022)	(0.018)	(0.013)	(0.015)	(0.424)
VOLAT	0.001***	0.004***	0.037***	0.131**	0.006	-0.004	-0.002	-0.005	-0.003	-0.001	-0.005*	-0.158*
	(0.000)	(0.001)	(0.012)	(0.054)	(0.011)	(0.006)	(0.004)	(0.005)	(0.003)	(0.003)	(0.003)	(0.085)
QUOTES	-0.000*	-0.000***	-0.002**	-0.009**	-0.001**	-0.001**	-0.001***	-0.001**	-0.001***	-0.001***	-0.001***	0.018***
	(0.000)	(0.000)	(0.001)	(0.004)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.006)
TRADES	0.000***	0.001***	0.005***	0.015***	0.004***	0.003***	0.002***	0.002***	0.002***	0.002***	0.002***	-0.039***
	(0.000)	(0.000)	(0.001)	(0.005)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.008)
γ	0.000***	0.001***	0.005***	0.015***	0.004***	0.003***	0.002***	0.002***	0.002***	0.002***	0.002***	-0.098**
	(0.000)	(0.000)	(0.001)	(0.005)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.045)
# obs.	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200
# sym.	40	40	40	40	40	40	40	40	40	40	40	40
Adj. R^2	-0.001	0.075	0.095	0.136	0.137	0.112	0.081	0.046	0.053	0.047	0.037	0.174
Panel C: medium stocks												
POST	-0.000	-0.000	-0.002*	-0.031***	-0.001**	-0.001*	0.000	-0.000	-0.000	-0.000	0.000*	0.035***
	(0.000)	(0.000)	(0.001)	(0.007)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.009)
IPRICE	-0.001	-0.023	-0.046	-0.473	-0.070**	-0.056**	-0.048*	-0.059*	-0.027	-0.019	-0.024**	0.846
	(0.002)	(0.014)	(0.077)	(0.436)	(0.031)	(0.028)	(0.026)	(0.034)	(0.018)	(0.014)	(0.010)	(0.645)
VOLAT	0.001	0.011***	0.043*	0.123	0.007	-0.002	-0.006	-0.002	-0.007*	0.004	0.003	-0.174
	(0.000)	(0.003)	(0.024)	(0.099)	(0.009)	(0.004)	(0.009)	(0.006)	(0.004)	(0.004)	(0.004)	(0.127)
QUOTES	-0.000	0.000*	0.005***	0.018*	0.003***	0.001*	0.001***	0.001	0.001*	0.001*	0.001**	-0.032**
	(0.000)	(0.000)	(0.002)	(0.010)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.014)
TRADES	0.000***	0.000**	0.000	-0.006	-0.000	0.001**	0.001*	0.000	0.001*	-0.000	-0.000	0.003
	(0.000)	(0.000)	(0.001)	(0.007)	(0.001)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.010)
γ	-0.001*	-0.005**	0.026**	-0.080**	-0.001	0.003	-0.003	0.005	0.005**	0.006***	0.002	0.044
	(0.000)	(0.002)	(0.011)	(0.037)	(0.006)	(0.003)	(0.004)	(0.003)	(0.002)	(0.002)	(0.003)	(0.050)
# obs.	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200
# sym.	40	40	40	40	40	40	40	40	40	40	40	40
Adj. R^2	-0.004	0.044	0.074	0.256	0.070	0.017	0.010	0.000	0.001	-0.005	-0.008	0.225

	1 µs	10 µs	100 µs	200 µs	300 µs	400 µs	500 µs	600 µs	700 µs	800 µs	900 µs	900+ µs
Panel D: small stocks												
$POST$	-0.000	0.000	-0.000	-0.029***	-0.001**	-0.001**	-0.001	-0.001*	-0.000	-0.000	-0.000	0.033***
	(0.000)	(0.000)	(0.001)	(0.005)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.006)
$IPRICE$	0.000	-0.006***	-0.022***	-0.013	-0.009	-0.001	-0.006	-0.003	0.004	-0.007	-0.003	0.064
	(0.000)	(0.002)	(0.008)	(0.149)	(0.011)	(0.009)	(0.009)	(0.008)	(0.006)	(0.010)	(0.006)	(0.202)
$VOLAT$	0.001	0.006	-0.011	0.084	-0.011**	-0.006	-0.006	-0.005	-0.009***	0.001	-0.003	-0.040
	(0.001)	(0.004)	(0.009)	(0.067)	(0.005)	(0.005)	(0.005)	(0.004)	(0.003)	(0.005)	(0.005)	(0.077)
$QUOTES$	0.000	0.001**	0.004***	0.049***	0.003***	0.001**	0.001*	0.001	0.000	0.001**	-0.000	-0.061***
	(0.000)	(0.000)	(0.001)	(0.007)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.009)
$TRADES$	-0.000	-0.000	0.001	-0.029***	0.000	0.001	0.001*	0.001***	0.001***	-0.000	-0.000	0.025***
	(0.000)	(0.000)	(0.001)	(0.005)	(0.001)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.006)
γ	-0.001*	-0.008***	0.032***	-0.036	-0.001	0.008*	0.006*	0.004	0.004	0.007**	0.004	-0.022
	(0.000)	(0.002)	(0.011)	(0.035)	(0.006)	(0.005)	(0.004)	(0.004)	(0.003)	(0.003)	(0.004)	(0.049)
# obs.	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200
# sym.	40	40	40	40	40	40	40	40	40	40	40	40
Adj. R^2	-0.010	0.012	0.018	0.283	0.042	-0.002	0.000	0.002	-0.003	-0.008	-0.013	0.239

Table A3: Quote revisions and cancellations (full regression results)

The table examines the speed of limit order revisions and cancellations on Nasdaq following a trade on a remote market (i.e., the NYSE family of exchanges or BATS and Direct Edge exchanges). The speed is measured as the difference between the time a top of the book limit order to buy/sell on Nasdaq is revised or cancelled and the time a sell/buy trade on a remote market was executed. We split limit order revisions and cancellations into 1, 2, 3, 4, 5, 10, 100, and 100+ millisecond buckets. We then compute the proportion of limit order revisions and cancellations in each bucket. The table contains coefficient estimates for the full sample (Panel A), large (Panel B), medium (Panel C), and small (Panel D) stocks from the following regression:

$$DEPVAR_{it} = \alpha_i + \gamma_t + \beta_1 POST_t + \beta_2 IPRICE_{it} + \beta_3 VOLAT_{it} + \beta_4 QUOTES_{it} + \beta_5 TRADES_{it} + \varepsilon_{it},$$

where $DEPVAR_{it}$ is the proportion of revisions and cancellation in each time bucket for stock i on day t, $POST$ is a post-CCTP dummy, $IPRICE$ is the inverse of the stock price, $VOLAT$ is the daily high minus low price scaled by the high price, $QUOTES$ is the natural log of the number of top-of-the-book limit orders, $TRADES$ is the natural log of the number of DTAQ trades, and γ_t is a trend variable. The regressions control for stock fixed effects. Double-clustered standard errors are in parentheses. Asterisks ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels.

	1 ms	2 ms	3 ms	4 ms	5 ms	10 ms	100 ms	100+ ms
Panel A: full sample								
$POST$	0.004***	0.004***	0.003***	0.002*	0.001*	0.001	-0.005**	-0.008**
	(0.001)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.002)	(0.003)
$IPRICE$	-0.025	-0.006	0.015	0.015*	0.016**	0.055***	-0.139*	0.068
	(0.023)	(0.016)	(0.011)	(0.009)	(0.008)	(0.021)	(0.074)	(0.110)
$VOLAT$	-0.024***	-0.020**	-0.010	-0.003	-0.002	-0.016	-0.056*	0.133**
	(0.009)	(0.008)	(0.007)	(0.005)	(0.004)	(0.012)	(0.034)	(0.054)
$QUOTES$	0.000	-0.000	-0.001**	-0.001***	-0.001***	-0.001	0.003	0.002
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)	(0.002)	(0.003)
$TRADES$	-0.002***	-0.002***	-0.002***	-0.002***	-0.002***	-0.005***	-0.009***	0.025***
	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.002)	(0.003)
γ	0.000***	0.000***	0.000***	0.000**	0.000**	0.000***	0.000	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
# obs.	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600
# sym.	120	120	120	120	120	120	120	120
Adj. R2	0.379	0.332	0.255	0.191	0.141	0.128	0.016	0.255
Panel B: large stocks								
$POST$	0.004***	0.004***	0.003***	0.001	0.001*	0.001	-0.010***	-0.004
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.002)	(0.004)
$IPRICE$	-0.070	-0.027	0.012	0.000	-0.013	-0.046	-0.360*	0.504*
	(0.060)	(0.045)	(0.030)	(0.019)	(0.016)	(0.065)	(0.215)	(0.258)
$VOLAT$	-0.035**	-0.030**	-0.022*	-0.012	-0.008	-0.020	-0.065	0.191**
	(0.015)	(0.014)	(0.011)	(0.009)	(0.007)	(0.017)	(0.044)	(0.089)
$QUOTES$	0.000	0.001	0.001	0.001	0.001	0.001	0.008***	-0.013**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.003)	(0.005)
$TRADES$	-0.005***	-0.005***	-0.004***	-0.004***	-0.003***	-0.007***	-0.016***	0.044***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.003)	(0.005)
γ	0.080***	0.042***	0.015	0.005	0.006	0.041**	0.012	-0.199***
	(0.014)	(0.013)	(0.011)	(0.007)	(0.005)	(0.016)	(0.037)	(0.052)
# obs.	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200
# sym.	40	40	40	40	40	40	40	40
Adj. R2	0.520	0.435	0.304	0.224	0.206	0.209	0.094	0.317

	1 ms	2 ms	3 ms	4 ms	5 ms	10 ms	100 ms	100+ ms
Panel C: medium stocks								
$POST$	0.003***	0.003***	0.002***	0.001*	0.001	0.001	-0.002	-0.008***
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)	(0.003)	(0.002)
$IPRICE$	-0.022	0.013	0.034	0.046**	0.031*	0.091*	-0.270	0.076
	(0.075)	(0.042)	(0.031)	(0.023)	(0.018)	(0.047)	(0.189)	(0.259)
$VOLAT$	-0.034**	-0.035**	-0.021**	-0.013*	-0.010	-0.036*	-0.016	0.165*
	(0.015)	(0.014)	(0.010)	(0.007)	(0.006)	(0.021)	(0.049)	(0.087)
$QUOTES$	0.001	0.000	-0.001	-0.001***	-0.001***	-0.002**	0.004	0.001
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.003)	(0.004)
$TRADES$	-0.002***	-0.002***	-0.002***	-0.002***	-0.001***	-0.003***	-0.011***	0.023***
	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.003)	(0.003)
γ	0.077***	0.058***	0.032***	0.018***	0.013**	0.053***	0.056	-0.306***
	(0.012)	(0.010)	(0.008)	(0.007)	(0.006)	(0.014)	(0.054)	(0.071)
# obs.	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200
# sym.	40	40	40	40	40	40	40	40
Adj. R2	0.374	0.326	0.255	0.200	0.155	0.178	0.022	0.281
Panel D: small stocks								
$POST$	0.003***	0.004***	0.003***	0.002**	0.001	0.002	-0.002	-0.013***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.003)	(0.005)
$IPRICE$	-0.027	-0.015	0.004	0.005	0.013	0.055**	-0.108*	0.073
	(0.023)	(0.019)	(0.012)	(0.010)	(0.009)	(0.024)	(0.058)	(0.103)
$VOLAT$	-0.017**	-0.006	0.005	0.011	0.008	-0.004	-0.065	0.068
	(0.008)	(0.009)	(0.008)	(0.008)	(0.006)	(0.018)	(0.046)	(0.073)
$QUOTES$	-0.000	-0.001*	-0.002***	-0.002***	-0.002***	-0.001	0.002	0.007
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.003)	(0.005)
$TRADES$	-0.000	-0.001*	-0.002***	-0.003***	-0.002***	-0.007***	-0.007***	0.021***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.002)	(0.004)
γ	0.061***	0.053***	0.040***	0.028***	0.019**	0.029	0.066	-0.296***
	(0.012)	(0.010)	(0.008)	(0.008)	(0.008)	(0.020)	(0.056)	(0.075)
# obs.	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200
# sym.	40	40	40	40	40	40	40	40
Adj. R2	0.276	0.288	0.270	0.222	0.147	0.087	0.008	0.238

Table A4: Quote and trade submissions (full regression results)

The table contains coefficient estimates for the full sample (Panel A), large (Panel B), medium (Panel C), and small (Panel D) stocks from the following regression:

$$DEPVAR_{it} = \alpha_i + \gamma_t + \beta_1 POST_t + \beta_2 IPRICE_{it} + \beta_3 VOLAT_{it} + \varepsilon_{it},$$

where $DEPVAR_{it}$ is the log-transformed number of quotes or trades for stock i on day t, $POST$ is a post-CCTP dummy, $IPRICE$ is the inverse of the stock price, and $VOLAT$ is the daily high minus low price scaled by high price. The regressions control for stock fixed effects. Double-clustered standard errors are in parentheses. Asterisks ***, ** and * indicate significance at the 1%, 5% and 10% levels.

	QUOTES	*TRADES*	*QUOTES*	*TRADES*	*QUOTES*	*TRADES*	*QUOTES*	*TRADES*
	Panel A: full sample		Panel B: large stocks		Panel C: med. stocks		Panel D: small stocks	
POST	-0.280***	-0.168***	-0.280***	-0.186***	-0.275***	-0.190***	-0.289***	-0.131**
	(0.056)	(0.053)	(0.059)	(0.057)	(0.067)	(0.063)	(0.055)	(0.056)
IPRICE	-0.139	1.238	-0.119	-0.671	-1.741	-0.927	0.250	1.798*
	(1.168)	(1.287)	(3.489)	(2.958)	(4.526)	(4.338)	(0.922)	(1.012)
VOLAT	4.394***	6.974***	3.713***	7.112***	4.434***	7.609***	4.610***	6.577***
	(0.629)	(0.654)	(1.292)	(1.382)	(1.022)	(1.153)	(0.523)	(0.600)
γ	-1.370**	0.548	-0.300	0.534	-2.202***	0.229	-1.632**	0.810
	(0.603)	(0.574)	(0.665)	(0.645)	(0.699)	(0.667)	(0.673)	(0.645)
# obs.	9,600	9,600	3,200	3,200	3,200	3,200	3,200	3,200
# sym.	120	120	40	40	40	40	40	40
Adj. R^2	0.306	0.138	0.267	0.181	0.318	0.154	0.340	0.109

Table A5: NBBO, effective and realized spreads (full regression output)

The table contains coefficient estimates for NBBO, effective (ESP) and realized spreads (RSP) for the full sample (Panel A), large (Panel B), medium (Panel C), and small (Panel D) stocks from the following regression:

$$DEPVAR_{it} = \alpha_i + \gamma_t + \beta_1 POST_t + \beta_2 IPRICE_{it} + \beta_3 VOLAT_{it} + \beta_4 TURN_{it} + \varepsilon_{it}$$

where $DEPVAR_{it}$ is one of the variables of interest for stock i on day t, $POST$ is a post-CCTP dummy, $IPRICE$ is the inverse of the stock price, $VOLAT$ is the daily high minus low price scaled by the high price, $TURN$ is daily volume scaled by the number of shares outstanding, and γ_t is a trend variable. The regressions control for stock fixed effects. Double-clustered standard errors are in parentheses. Asterisks ***, ** and * indicate significance at the 1%, 5% and 10% levels.

	$NBBO$	ESP	$RSP1s$	$RSP5s$	$RSP15s$	$NBBO$	ESP	$RSP1s$	$RSP5s$	$RSP15s$
	Panel A: full sample					Panel B: large stocks				
$POST$	-0.006***	-0.004***	-0.001	0.001	0.001	-0.002***	-0.002**	0.001	0.001	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)
$IPRICE$	0.957***	0.904***	0.633***	0.533***	0.394***	0.957***	1.006***	0.931***	0.731***	0.552***
	(0.030)	(0.032)	(0.042)	(0.072)	(0.093)	(0.015)	(0.033)	(0.144)	(0.132)	(0.148)
$VOLAT$	0.077**	0.119***	0.083**	0.040	0.002	0.017*	0.021	-0.045*	-0.057**	-0.067**
	(0.032)	(0.044)	(0.032)	(0.033)	(0.039)	(0.009)	(0.031)	(0.024)	(0.024)	(0.028)
$TURN$	-0.061**	0.296**	0.193*	0.100	0.078	0.056*	0.591***	0.637***	0.584***	0.543***
	(0.029)	(0.118)	(0.111)	(0.114)	(0.098)	(0.030)	(0.094)	(0.103)	(0.097)	(0.107)
γ	-0.026***	-0.029***	-0.029***	-0.018	-0.015	-0.002	0.001	0.001	0.004	0.000
	(0.008)	(0.010)	(0.010)	(0.012)	(0.012)	(0.002)	(0.007)	(0.011)	(0.011)	(0.010)
# obs.	9,600	9,600	9,600	9,600	9,600	3,200	3,200	3,200	3,200	3,200
# sym.	120	120	120	120	120	40	40	40	40	40
Adj. R^2	0.432	0.093	0.036	0.014	0.001	0.510	0.113	0.068	0.041	0.026
	Panel C: medium stocks					Panel D: small stocks				
$POST$	-0.006***	-0.004**	-0.001	0.001	0.003	-0.011***	-0.005***	-0.001	0.001	0.002
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
$IPRICE$	0.882***	0.929***	0.470***	0.363***	0.210	0.986***	0.888***	0.643***	0.554***	0.420***
	(0.079)	(0.119)	(0.114)	(0.121)	(0.158)	(0.029)	(0.029)	(0.038)	(0.081)	(0.100)
$VOLAT$	0.044	0.012	-0.006	-0.026	-0.030	0.103**	0.217***	0.179***	0.111**	0.045
	(0.032)	(0.047)	(0.039)	(0.041)	(0.041)	(0.049)	(0.063)	(0.046)	(0.056)	(0.074)
$TURN$	-0.015	0.591*	0.491*	0.422	0.366*	-0.085	0.084	-0.040	-0.155**	-0.159
	(0.038)	(0.305)	(0.278)	(0.278)	(0.213)	(0.055)	(0.068)	(0.038)	(0.064)	(0.104)
γ	-0.017	-0.029**	-0.025	-0.015	-0.010	-0.061***	-0.060***	-0.061***	-0.046*	-0.038
	(0.011)	(0.013)	(0.016)	(0.015)	(0.015)	(0.017)	(0.017)	(0.020)	(0.023)	(0.025)
# obs.	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200	3,200
# sym.	40	40	40	40	40	40	40	40	40	40
Adj. R^2	0.370	0.053	0.016	0.002	0.002	0.496	0.149	0.069	0.039	0.013

Table A6: Quoted depth, queue length, and volatility (full regression results)

The table contains quoted depth, queue length, and volatility regressions estimated around the November 30, 2011 implementation of the CCTP:

$$DEPVAR_{it} = \alpha_i + \gamma_t + \beta_1 POST_t + \beta_2 IPRICE_{it} + \beta_3 VOLAT_{it} + \beta_4 TURN_{it} + \varepsilon_{it}$$

where $DEPVAR_{it}$ is one of the three variables of interest for stock i on day t, $POST$ is a post-CCTP dummy, $IPRICE$ is the inverse of the stock price, $VOLAT$ is the daily high minus low price scaled by the high price, $TURN$ is daily volume scaled by the number of shares outstanding, and γ_t is a trend variable. We do not control for $VOLAT$ when volatility is the dependent variable. The regressions control for stock fixed effects. Double-clustered standard errors are in parentheses. Asterisks ***, ** and * indicate significance at the 1%, 5% and 10% levels.

	DEPTH	*QLENGTH*	*VOLAT*	*DEPTH*	*QLENGTH*	*VOLAT*
	Panel A: full sample			Panel B: large stocks		
POST	0.128***	2.502***	-0.006***	0.283***	6.306***	-0.003**
	(0.024)	(0.421)	(0.002)	(0.038)	(0.885)	(0.001)
IPRICE	4.853***	76.368***	0.254***	14.788***	531.326***	0.318
	(1.753)	(29.212)	(0.070)	(3.471)	(159.156)	(0.206)
VOLAT	-0.797	-21.120***		-4.487***	-91.851***	
	(0.504)	(5.975)		(0.718)	(20.646)	
TURN			0.372***			0.794***
			(0.060)			(0.178)
γ	0.994***	14.014***	-0.026*	1.216***	43.773***	-0.031**
	(0.221)	(3.636)	(0.014)	(0.462)	(10.274)	(0.013)
# obs.	9,600	9,600	9,600	3,200	3,200	3,200
# sym.	120	120	120	40	40	40
Adj. R^2	0.079	0.103	0.123	0.284	0.265	0.149
	Panel C: medium stocks			Panel D: small stocks		
POST	0.044*	0.492***	-0.006***	0.050*	0.541***	-0.008***
	(0.022)	(0.147)	(0.002)	(0.026)	(0.134)	(0.002)
IPRICE	6.187*	59.776*	0.250***	3.897**	50.487***	0.258***
	(3.542)	(34.759)	(0.084)	(1.565)	(10.907)	(0.074)
VOLAT	-0.242	-12.608***		-0.230	-10.705***	
	(0.800)	(3.603)		(0.419)	(4.148)	
TURN			0.358***			0.332***
			(0.102)			(0.060)
γ	1.142***	6.659***	-0.019	0.820***	2.932	-0.027*
	(0.260)	(2.409)	(0.016)	(0.237)	(2.607)	(0.016)
# obs.	3,200	3,200	3,200	3,200	3,200	3,200
# sym.	40	40	40	40	40	40
Adj. R^2	0.025	0.103	0.110	0.037	0.144	0.132

Table A7: Price impacts around July 14, 2011 and April 15, 2014 events (full regression results)

The table reports coefficient estimates from the following regression estimated around the July 14, 2011 implementation of Rule 15c3-5 and the April 15, 2014 release of the FAQ by the SEC:

$$DEPVAR_{it} = \alpha_i + \gamma_t + \beta_1 POST_t + \beta_2 IPRICE_{it} + \beta_3 VOLAT_{it} + \beta_4 TURN_{it} + \varepsilon_{it},$$

where $DEPVAR_{it}$ is one of the three price impact metrics (estimated using 1-, 5- and 15-second horizons) for stock i on day t, $POST$ is a post-CCTP dummy, $IPRICE$ is the inverse of the stock price, $VOLAT$ is the daily high minus low price scaled by the high price, $TURN$ is daily volume scaled by the number of shares outstanding, and γ_t is a trend variable. The long (short) window around the July 2011 event contains 4 months (20 trading days). The window around the April 2014 event contains 4 months. The regressions control for stock fixed effects. Double-clustered standard errors are in parentheses. Asterisks ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels.

	$PRIMP1s$	$PRIMP5s$	$PRIMP15s$	$PRIMP1s$	$PRIMP5s$	$PRIMP15s$	$PRIMP1s$	$PRIMP5s$	$PRIMP15s$
	July 14, 2011 (long window)			July 14, 2011 (short window)			April 15, 2014		
$POST$	0.002*	0.002	0.002	0.002	0.002	0.002	0.004	0.004	0.005
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.003)	(0.003)	(0.003)
$IPRICE$	0.446***	0.562***	0.667***	-0.049	0.140	0.152	0.011	0.082	0.131
	(0.038)	(0.073)	(0.094)	(0.291)	(0.400)	(0.363)	(0.226)	(0.260)	(0.271)
$VOLAT$	0.090***	0.134***	0.176***	-0.003	-0.002	-0.010	1.458	1.659	1.782*
	(0.014)	(0.025)	(0.033)	(0.027)	(0.030)	(0.034)	(1.002)	(1.062)	(1.054)
$TURN$	0.072***	0.242**	0.268**	0.135	0.240*	0.342**	-0.439	-0.361	-0.370
	(0.027)	(0.103)	(0.122)	(0.083)	(0.125)	(0.172)	(0.303)	(0.327)	(0.324)
γ	0.070	0.047	0.041	0.013	0.051	0.049	-0.014	-0.082*	-0.053
	(0.081)	(0.053)	(0.063)	(0.017)	(0.050)	(0.052)	(0.024)	(0.069)	(0.074)
# obs.	9,600	9,600	9,600	2,640	2,640	2,640	9,600	9,600	9,600
# sym.	120	120	120	120	120	120	120	120	120
Adj. R^2	0.307	0.296	0.274	0.013	0.011	0.010	0.135	0.151	0.171

Table A8: Changes to spread components: base model, VIX as a control, and dollar figures

The table reports spread decomposition statistics: price impacts (Panels A through C) as well as effective and realized spreads (Panels D through F) estimated around the November 30, 2011 implementation of the CCTP. Panels A and D report the results from the base model:

$$DEPVAR_{it} = \alpha_i + \gamma_t + \beta_1 POST_t + \varepsilon_{it},$$

Panels B and E replace stock's own volatility with a VIX control:

$$DEPVAR_{it} = \alpha_i + \gamma_t + \beta_1 POST_t + \beta_2 IPRICE_{it} + \beta_3 VIX_t + \beta_4 TURN_{it} + \varepsilon_{it},$$

and Panels C and F return to controlling for the stock's own volatility, but use the spread and price impact metrics expressed in cents instead of metrics scaled by the corresponding NBBO midpoint:

$$DEPVAR_{it} = \alpha_i + \gamma_t + \beta_1 POST_t + \beta_2 IPRICE_{it} + \beta_3 VOLAT_{it} + \beta_4 TURN_{it} + \varepsilon_{it},$$

where $DEPVAR_{it}$ is the variable of interest for stock i on day t (i.e., price impact, effective spread, or realized spread), $POST$ is a post-CCTP dummy, $IPRICE$ is the inverse of the stock price, $VOLAT$ is the daily high minus low price scaled by the high price, VIX is the CBOE volatility index, $TURN$ is daily volume scaled by the number of shares outstanding, and γ_t is a trend variable. The regressions control for stock fixed effects. Double-clustered standard errors are in parentheses. Asterisks ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels.

	$PRIMP1s$	$PRIMP5s$	$PRIMP15s$	$PRIMP1s$	$PRIMP5s$	$PRIMP15s$	$PRIMP1s$	$PRIMP5s$	$PRIMP15s$
	Panel A: base model			Panel B: VIX control			Panel C: $DEPVAR$ in cents		
$POST$	-0.004***	-0.006***	-0.007***	-0.004***	-0.005***	-0.006***	-0.122***	-0.190***	-0.265***
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.024)	(0.037)	(0.051)
$IPRICE$				0.249***	0.350***	0.493***	-1.581	-2.071	-2.329
				(0.040)	(0.060)	(0.076)	(0.978)	(1.299)	(1.639)
$VOLAT$							0.887**	1.581***	2.313***
							(0.412)	(0.586)	(0.788)
VIX				0.001*	0.001**	0.001*			
				(0.000)	(0.000)	(0.000)			
$TURN$				0.104***	0.206***	0.243***	1.980***	3.873***	3.361**
				(0.035)	(0.059)	(0.082)	(0.588)	(0.989)	(1.359)
γ	-0.009	-0.024**	-0.033**	0.010	0.009	0.007	0.243	-0.590*	-0.706*
	(0.008)	(0.011)	(0.014)	(0.010)	(0.012)	(0.014)	(0.226)	(0.311)	(0.383)
# obs.	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600
# sym.	120	120	120	120	120	120	120	120	120
Adj. R^2	0.019	0.037	0.042	0.053	0.093	0.104	0.039	0.056	0.054

	ESP	$RSP1s$	$RSP5s$	$RSP15s$	ESP	$RSP1s$	$RSP5s$	$RSP15s$	ESP	$RSP1s$	$RSP5s$	$RSP15s$
	Panel D: base model				Panel E: VIX control				Panel F: $DEPVAR$ in cents			
$POST$	-0.005***	-0.001	0.001	0.001	-0.004***	-0.001	0.001	0.001	-0.220***	-0.098*	-0.030	0.045
	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.065)	(0.050)	(0.046)	(0.046)
$IPRICE$					0.893***	0.645***	0.545***	0.401***	-4.029	-2.447	-1.958	-1.699
					(0.036)	(0.045)	(0.069)	(0.085)	(2.678)	(1.814)	(1.518)	(1.188)
$VOLAT$									2.635**	1.749**	1.054	0.322
									(1.098)	(0.836)	(0.765)	(0.708)
VIX					0.001*	0.000	-0.000	-0.000				
					(0.000)	(0.000)	(0.000)	(0.000)				
$TURN$					0.313***	0.207*	0.104	0.068	1.870	-0.110	-2.003	-1.491
					(0.118)	(0.111)	(0.115)	(0.100)	(3.069)	(2.964)	(3.239)	(2.729)
γ	-0.063***	-0.054***	-0.039***	-0.029**	-0.014	-0.024**	-0.023**	-0.021*	-1.142**	-0.899**	-0.552	-0.436
	(0.016)	(0.015)	(0.013)	(0.012)	(0.015)	(0.011)	(0.012)	(0.011)	(0.477)	(0.417)	(0.383)	(0.373)
# obs.	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600	9,600
# sym.	120	120	120	120	120	120	120	120	120	120	120	120
Adj. R^2	0.008	-0.006	-0.011	-0.012	0.081	0.031	0.013	0.001	0.004	-0.008	-0.012	-0.013

Table A9: Trend varies across size categories

The table reports coefficient estimates from the following regression:

$$DEPVAR_{it} = \alpha_0 + \gamma_t + \beta_1 POST_t + \beta_2 \gamma \times GROUP2_{it} + \beta_3 \gamma \times GROUP3_{it} + \beta_4 GROUP2_{it} + \beta_5 GROUP3_{it} + \beta_6 IPRICE_{it} + \beta_7 VOLAT_{it} + \beta_8 TURN_{it} + \varepsilon_{it},$$

where $DEPVAR_{it}$ is one of the three price impact metrics for stock i on day t, $POST$ is a post-CCTP dummy, $GROUP2$ and $GROUP3$ are dummy variables for the medium and small stocks, $IPRICE$ is the inverse of the stock price, $VOLAT$ is the daily high minus low price scaled by the high price, $TURN$ is daily volume scaled by the number of shares outstanding, and γ_t is a trend variable. Double-clustered standard errors are in parentheses. Asterisks ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels.

	$PRIMP1s$	$PRIMP5s$	$PRIMP15s$
$POST$	-0.003***	-0.004***	-0.005***
	(0.001)	(0.001)	(0.001)
γ	0.010	0.016*	0.038*
	(0.007)	(0.009)	(0.031)
$\gamma \times GROUP2$	-0.007	-0.028	-0.009
	(0.009)	(0.031)	(0.012)
$\gamma \times GROUP3$	-0.008	-0.010	-0.009
	(0.011)	(0.015)	(0.020)
$GROUP2$	1.398	5.717***	11.834***
	(1.711)	(2.156)	(2.324)
$GROUP3$	1.607	7.991***	18.183***
	(2.195)	(3.046)	(4.018)
$IPRICE$	0.322***	0.392***	0.432***
	(0.030)	(0.026)	(0.026)
$VOLAT$	0.138***	0.199***	0.264***
	(0.020)	(0.028)	(0.039)
$TURN$	0.119***	0.209***	0.254***
	(0.038)	(0.049)	(0.071)
$CONSTANT$	-1.928	-3.284*	-7.597***
	(1.437)	(1.777)	(2.173)
# obs.	9,600	9,600	9,600
Adj. R^2	0.646	0.678	0.653

Table A10: Price impacts around a placebo date, November 30, 2012

Panel A reports coefficients from the regression estimated during a four-month window around a placebo date, November 30, 2012 (this date is one year removed from the CCTP implementation date in 2011):

$$DEPVAR_{it} = \alpha_i + \gamma_t + \beta_1 POST_t + \beta_2 IPRICE_{it} + \beta_3 VOLAT_{it} + \beta_4 TURN_{it} + \varepsilon_{it},$$

where $DEPVAR_{it}$ is one of the three price impact metrics (using the 1-, 5- and 15-second horizons) for stock i on day t, $POST$ is a post-November 30, 2012 dummy, $IPRICE$ is the inverse of the stock price, $VOLAT$ is the daily high minus low price scaled by the high price, $TURN$ is daily volume scaled by the number of shares outstanding, and γ_t is a trend variable. Panel B reports coefficient estimates from the following regression that pools the four-month event windows around the CCTP implementation (October 2011 through January 2012) and around the placebo event (October 2012 through January 2013):

$$DEPVAR_{it} = \alpha_i + \gamma_t + \beta_1 POST_t + \beta_2 POST \times YR2011_t + \beta_3 YR2011_t + \beta_4 IPRICE_{it} + \beta_5 VOLAT_{it} + \beta_6 TURN_{it} + \varepsilon_{it},$$

where $POST$ is a dummy capturing the December-January effects in each sample period and $YR2011$ is a dummy capturing the incremental effects of the CCTP in 2011. The regressions control for stock fixed effects. Double-clustered standard errors are in parentheses. Asterisks ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels.

	$PRIMP1s$	$PRIMP5s$	$PRIMP15s$
Panel A: Regressions for the placebo period surrounding November 30, 2012			
$POST$	-0.001	-0.001	-0.002
	(0.001)	(0.002)	(0.001)
$IPRICE$	0.284***	0.378***	0.397***
	(0.098)	(0.087)	(0.085)
$VOLAT$	0.013	0.022	0.049*
	(0.023)	(0.027)	(0.030)
$TURN$	0.064	0.170***	0.199***
	(0.040)	(0.049)	(0.048)
γ	-0.032**	-0.037**	-0.044***
	(0.015)	(0.017)	(0.016)
# obs.	9,600	9,600	9,600
# sym.	120	120	120
Adj. R^2	0.010	0.025	0.023
Panel B: Regressions combining the event and placebo periods (Nov. 30, 2011 and Nov. 30, 2012)			
$POST$	-0.001	-0.002	-0.002
	(0.001)	(0.001)	(0.001)
$POST \times YR2011$	-0.002**	-0.004***	-0.006***
	(0.001)	(0.001)	(0.001)
$YR2011$	-0.002	0.001	0.003**
	(0.001)	(0.001)	(0.002)
$IPRICE$	0.323***	0.409***	0.464***
	(0.065)	(0.061)	(0.052)
$VOLAT$	0.040**	0.075***	0.119***
	(0.016)	(0.021)	(0.026)
$TURN$	0.047**	0.144***	0.171***
	(0.021)	(0.031)	(0.041)
γ	-0.015*	-0.023**	-0.029***
	(0.009)	(0.010)	(0.010)
# obs.	19,200	19,200	19,200
# sym.	120	120	120
Adj. R^2	0.063	0.106	0.118

Table A11: Liquidity taker reaction speed, with non-linear relations for quotes and trades

The table revisits the analysis in Tables 2 and A2 focussing on the 200 microsecond (µs), 300 µs, and 400 µs time buckets, while allowing for a non-linear relation for quote and trade controls. We estimate the following regression:

$$DEPVAR_{it} = \alpha_i + \gamma_t + \beta_1 POST_t + \beta_2 IPRICE_{it} + \beta_3 VOLAT_{it} + \beta_4 QUOTES_{it} + \beta_5 QUOTES_{it}^2 + \beta_6 TRADES_{it} + \beta_7 TRADES_{it}^2 + \varepsilon_{it},$$

where $DEPVAR_{it}$ is the proportion of top of the book executions in the 200 µs, 300 µs and 400 µs buckets for stock i on day t, $POST$ is a post-CCTP dummy, $IPRICE$ is the inverse of the stock price, $VOLAT$ is the daily high minus low price scaled by the high price, $QUOTES$ is the number of quotes scaled by 100,000, $TRADES$ is the number of trades scaled by 100,000, and γ_t is a trend variable. The regressions control for stock fixed effects. Double-clustered standard errors are in parentheses. Asterisks ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels.

	200 µs	300 µs	400 µs
$POST$	-0.027***	-0.002***	-0.001***
	(0.004)	(0.000)	(0.000)
$IPRICE$	-0.175	-0.022	-0.010
	(0.167)	(0.017)	(0.014)
$VOLAT$	0.197***	0.008	0.003
	(0.062)	(0.005)	(0.003)
$QUOTES$	0.000	0.001	0.000
	(0.003)	(0.000)	(0.000)
$QUOTES^2$	-0.000	-0.000**	-0.000
	(0.000)	(0.000)	(0.000)
$TRADES$	-0.015	0.007***	0.006***
	(0.016)	(0.002)	(0.001)
$TRADES^2$	0.007	-0.002***	-0.001***
	(0.004)	(0.001)	(0.000)
γ	-0.076***	0.000	0.006**
	(0.019)	(0.003)	(0.002)
# obs.	9,600	9,600	9,600
# sym.	120	120	120
Adj. R^2	0.168	0.041	0.008

Table A12: DTAQ and ITCH comparison

The table reports the price impact, effective spread and realized spread statistics estimated from DTAQ and ITCH data. We use two DTAQ samples: DTAQ data require estimation of trade direction using the Lee-Ready algorithm. In contrast, ITCH data contain the true trade originator. The latter data however require that we merge ITCH trades and DTAQ NBBO quotes to estimate the NBBO midpoints. ITCH data also contain odd lot trades, which DTAQ do not contain. For consistency, we drop the odd lots from the ITCH analysis. Panel A reports sample averages from two DTAQ samples: one includes trades from all exchanges (column 1) and the other focuses solely on Nasdaq trades (column 2); and from the ITCH sample that does not account for liquidity rebates (column 3) and the ITCH sample that assumes a liquidity rebate of 0.3 cents per share when computing the effective and realized spreads (column 4). Panel B reports the β_1 coefficients from the following regression:

$$DEPVAR_{it} = \alpha_i + \gamma_t + \beta_1 POST_t + \beta_2 IPRICE_{it} + \beta_3 VOLAT_{it} + \beta_4 TURN_{it} + \varepsilon_{it},$$

where $DEPVAR_{it}$ is one of the variables of interest for stock i on day t, $POST$ is a post-CCTP dummy, $IPRICE$ is the inverse of the stock price, $VOLAT$ is the daily high minus low price scaled by the high price, $TURN$ is daily volume scaled by the number of shares outstanding, and γ_t is a trend variable. The regressions control for stock fixed effects. Double-clustered standard errors are in parentheses. Asterisks ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels. All regressions contain 9,600 stock-day observations.

	Panel A: averages				Panel B: β_1 coefficients			
	DTAQ		ITCH		DTAQ		ITCH	
	all exch.	Nasdaq	w/o rebates	w/ rebates	all exch.	Nasdaq	w/o rebates	w/ rebates
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]
$PRIMP1s$	0.0282	0.0227	0.0669	0.0669	-0.004***	-0.004***	-0.005***	-0.005***
$PRIMP5s$	0.0365	0.0355	0.0765	0.0765	-0.005***	-0.005***	-0.006***	-0.006***
$PRIMP15s$	0.0439	0.0495	0.0820	0.0820	-0.007***	-0.006***	-0.007***	-0.007***
ESP	0.0671	0.0604	0.0619	0.0822	-0.004***	-0.005***	-0.006***	-0.005***
$RSP1s$	0.0388	0.0377	-0.0050	0.0153	-0.001	-0.001	-0.001	0.000
$RSP5s$	0.0306	0.0249	-0.0146	0.0057	0.001	0.000	0.000	0.000
$RSP15s$	0.0232	0.0109	-0.0201	0.0002	0.001	0.000	0.000	0.001

Table A13: Canadian non-interlisted stocks comparison

The table reports the number of quotes, trades and the Corwin-Schultz (2012) spread estimator, CS, for the sample of medium and small U.S. stocks and a sample of size-matched Canadian stocks around the implementation of the CCTP. We do not use large U.S. stocks because Canadian firms are generally much smaller. We exclude the interlisted Canadian firms that trade in the U.S. and therefore may be affected by the CCTP. The interlisted firms are generally larger than non-interlisted, further reducing the size of potential Canadian matches. U.S. quote and trade statistics are obtained from DTAQ, and CS is computed using CRSP data. Daily Canadian data are obtained from the Canadian Financial Markets Research Centre (CFMRC) database. Panel A reports sample averages and pre- and post-CCTP differences for the U.S. and Canadian samples. Panel B reports the β_1 coefficients from the following regression:

$$DEPVAR_{it} = \alpha_0 + \beta_1 POST_t + \beta_2 POST \times US_{it} + \beta_3 US_{it} + \beta_4 IPRICE_{it} + \beta_5 VOLAT_{it} + \beta_6 TURN_{it} + \varepsilon_{it},$$

where $DEPVAR_{it}$ is $TRADES$ (log-transformed), $QUOTES$ (log-transformed), or CS for stock i on day t, $POST$ is a post-CCTP dummy, US is the U.S. sample dummy, $IPRICE$ is the inverse of the stock price, $VOLAT$ is the daily high minus low price scaled by the high price, and $TURN$ is turnover (omitted in the regressions for quotes and trades). Double-clustered standard errors are in parentheses. Asterisks ***, ** and * indicate statistical significance at the 1%, 5% and 10% levels. In each Panel B regression, the number of observations is 12,800 and the number of stocks is 160 (80 U.S. stocks from the medium and small groups and 80 Canadian matches).

	US	CAN	diff. US	diff. CAN
Panel A: univariate comparisons				
$MCAP$, USD M	3,392	3,895		
$TRADES$	5,781	1,479	-1,059***	74
$QUOTES$	46,375	18,862	-18,514***	3,410***
$CSSE$	0.0080	0.0068	-0.0026***	-0.0009***

Panel B: regression setting	$POST$	$POST \times US$	US	$IPRICE$	$VOLAT$	$TURN$	$CONSTANT$	Adj. R^2
$TRADES$	0.0228	-0.1726***	1.8088***	2.0052***	18.0822***		5.9226***	0.428
	(0.0294)	(0.0417)	(0.0301)	(0.2360)	(0.5817)		(0.0266)	
$QUOTES$	0.0487**	-0.3194***	1.4106***	-3.030***	17.8899***		8.7661***	0.392
	(0.0243)	(0.0344)	(0.0248)	(0.1951)	(0.4809)		(0.0220)	
$CSSE$	-0.0004	-0.0016***	0.0014***	0.0188***	0.1023***	-0.0227**	0.0037***	0.052
	(0.0003)	(0.0004)	(0.0003)	(0.0026)	(0.0062)	(0.0114)	(0.0003)	